COLLEGE OF
OCEANIC &
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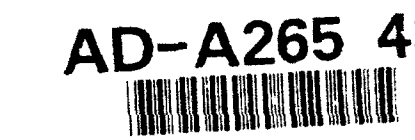

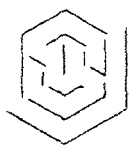

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May 3, 1993

Ms. Helen Shuff
Procurement Assistant
ONR
1107 NE 45th St., Suite 410
Seattle, WA 98105-4631

Your ref: N00014-90-J-1181

Dear Ms. Shuff:

I enclose a copy of a Final Technical report.

Yours sincerely,

Andrew F. Bennett
Professor of Oceanography

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encls.

cc: Dr. M. Fiadeiro
✓Defense Technical Information Center (DTIC)

FINAL TECHNICAL REPORT

Title: Diffusion by Inhomogeneous Turbulence
Office of Naval Research

Contract #: N00014-90-J-1181, 11/1/89 - 10/31/92

Principal Investigator: A. F. Bennett
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Goal: To enhance understanding of diffusion by inhomogeneous turbulence in the ocean.

Approach: Lagrangian velocity statistics, as sampled by a navigated drifter, may be related to Eulerian statistics, as sampled by a moored current meter. The relation is a Feynman path integral, which may be approximated using Monte Carlo methods. It was proposed to evaluate the integrals efficiently on a massively-parallel computer. A fundamental issue of interest is: are displacement statistics Gaussian when the turbulence is inhomogeneous? If Cocke's theorem applies, then the answer is in the affirmative. A sufficient condition is that drifter velocities decorrelate, at least at a certain rate.

Results: After lengthy effort, and after extended consultations with Thinking Machines Corporation, attempts to evaluate the Monte-Carlo integrals on the Connection Machine were abandoned. The difficulty lies in the linear algebra involved in calculating probabilities for random walks with correlated steps. Subsequent calculations were made with a single, fast workstation. These appeared at first to indicate non-Gaussian displacement statistics in inhomogeneous turbulence, but after vast sampling Gaussian statistics began to prevail. Only walks of moderate length (128 steps) could be managed; even so, many millions of trials were needed. In summary, the results were inconclusive, owing to inadequate computing resources.

Circumstances have changed. IBM has donated 5 very powerful workstations to the College. Members of the College have purchased about 10 similar systems. Oak Ridge National Laboratory has issued Parallel Virtual Machine ("pvm", version 3.0), which enables distributed-network computing. The Sandia Corporation at Lawrence Livermore National Laboratory has developed a reliable parallel random number generator. Finally, a very clever programmer (Mr. Rodney James) has joined the College. The Monte Carlo integrals may now be evaluated, using 15 powerful workstations in a loosely coupled configuration. The load is automatically rebalanced, should another user log to one of the systems. This enhanced computing capability (about 20 times faster) rivals the College's Connection Machines, and should resolve the question of the distribution of surge-particle displacement in inhomogeneous turbulence. Work will continue, with State support.